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ECLIPSE OF DECEMBER 21, 1889.

BY EDWARD S. HOLDEN.

The following extracts from the forthcoming Eclipse Report may have sufficient interest to justify their publication in advance of the main volume. They should be read in connection with preliminary reports on the negatives secured by the British parties, which are given in *The Observatory* for March, 1890, (page 105 (with a plate), and in the *Monthly Notices*, R. A. S., volume 50, pages 219 and 265:

"DIMENSIONS OF THE CORONA.

There are four main wings to the corona. For the purpose of describing them, I have used the following nomenclature:

I is the N. edge of the N. wing on the W. side of the sun.

II	"	S.	"	"	N.	"	"	W.	"	"	"
III	"	N.	"	"	S.	"	"	W.	"	"	"
IV	"	S.	"	"	S.	"	"	W.	"	"	"
V	"	S.	"	"	S.	"	"	E.	"	"	"
VI	"	N.	"	"	S.	"	"	E.	"	"	"
VII	"	S.	"	"	N.	"	"	E.	"	"	"
VIII	"	N.	"	"	N.	"	"	E.	"	"	"

I have measured on the negatives the distance from the moon's centre to the point where each of these faint edges terminates. The measures are entirely independent. It will be seen from the table below that the further one goes from the moon's centre the wider apart are the edges VIII and V.

TABLE I.—U. S. N. O. CAMERA NEGATIVES.

Negative.	Exposure.	Distance from the centre of the Moon to extreme point of the faint edge VIII.	Distance from the centre of the Moon to extreme point of the faint edge V.	Distance between the edges VIII and V at the distance from the Moon's centre given in column VIII.	Distance from the centre of the Moon to extreme point of the faint edge IV.	Distance from the centre of the Moon to extreme point of the axis of the wing I and II.
	Sec.	′	′	′	′	′
1*	5	82	86	46	77	72
2*	10	71	71	40	66	70
3	15	82±	85	46	72	71
5	20	77+	85	41	82	77
7†	23±	53	57	. .	63	62
		SIX-INCH CLARK TELESCOPE NEGATIVES.				
1‡	2	telescope	jarred.			
2	5	68	67	42	55	60
3	7	70	77	39	60	58
4‡	10	56	67	35	52	60
5	25	60	70	42	65	62
Last§	(?)	2-3	2-3	. .	2-3	2-3

EXTENSION OF THE OUTER CORONA.

The negatives of the December eclipse might not, of themselves, lead to the suspicion of the existence of this feature. The exact evidence which they yield is presented in Table I.

On the other hand, when these negatives are examined with the special object of finding such a feature, they yield no evidence against it. In fact, they show that the outer corona is some 45′ wide at 80′ from the moon's center, and that the beginning of the trumpet-shaped form is present. While it is to be regretted that the December negatives are not decisive on this point, this has little or nothing to do with the evidence upon which the existence of the extension of the outer corona rests.

I may be permitted to recapitulate this evidence, as follows: All of Mr. BARNARD's negatives of January, 1889, show a strongly marked

* Negatives 1 and 2 were standardized. † The Sun came out on 7 after III contact.

‡ Plates 1 and 4 were standardized. § Plate "Last" was spoiled by the sun coming out on

divergence in the edges of the outer corona beyond the 55′ circle, and his negative "C" enables us to trace this trumpet-shaped extension to 75′ or so. The negatives of Messrs. LOWDEN and IRELAND show the same outlines to 130′ and more.

The negatives of Father CHARROPPIN show the same thing, in a beautiful manner, out as far as 100′ or more. The same extension is more or less plainly shown on the negatives of Messrs. DORNIN, JOHNSON, TREAT, PASSAVANT, GRIMWOOD, LANGE, BURCKHALTER and TABER. These negatives were made by eleven different instruments at four widely-separated observing stations. Moreover, the naked-eye drawing of Miss TREAT shows the same feature exactly. It therefore appears to be certain that the extension of the outer corona first photographed in January, 1889, has an objective existence. The negatives of December, 1889, are not sufficient to prove the existence of such a feature; but, so far as they give any evidence at all, they confirm that obtained in the previous January.

The Eclipse Committee of the Royal Astronomical Society considered it "doubtful whether this extension has been photographed," and made a programme for the December eclipse which was designed to decide the question. It appears to have been the idea of the committee that with two instruments of different light-ratios, a/f, the extension would necessarily be greater (for the same exposure) in that instrument having the greater light-ratio. In their *Report* (*Mon. Not.*, R. A. S., vol. 50, p. 4) it is said: "The failure of exposures of say three minutes to give a sensibly greater extension than one minute, is adduced by Captain ABNEY as a reason for believing the evidence to be, on the whole, against the reality of coronal streamers." Special mirrors were constructed, of aperture 15 inches, focus 45 inches, for use at the December eclipse; "the chief point in the use of the mirrors is to get long-exposure pictures. Short exposures will also be of interest, but the question the mirrors were built to settle is the reality of the coronal extension" (by employing long exposures). In the *Monthly Notices* (vol. 50, p. 220 and p. 271) the Secretary of the Eclipse Committee has given a preliminary account of the negatives secured by the use of the mirrors above described ($a/f = 1/3$) and of cameras ($a/f = \frac{1}{15}$). The plates taken with the mirrors showed no greater extension than those taken with the cameras. "This result, however, does not appear to be conclusive; the failure of the fifteen-inch mirror to show more than the four-inch lens may apparently be due to some accidental and purely instrumental circumstance, * * * and is really a failure in instrumental

power and not in the light of the object photographed. It cannot be said that any definite conclusion has been arrived at with regard to the extension. It is almost certain that for some cause the twenty-inch mirror was not efficient on the occasion of the eclipse, and it is probable that it was dewed. With an effective aperture of fifteen inches, the short-exposure plates should have shown much more if the mirror had been in its normal state. Hence the failure to photograph the corona more than about a diameter from the limb in forty seconds cannot be taken as evidence against the possibility of photographing 'the extension' in the future" (with long exposures).

It appears to me that the questions involved should be regarded in a somewhat different way. If it is desired to photograph a faint nebula or star on the background of a perfectly dark night-sky, the method above suggested is the appropriate one. If, however, it is wished to record the slight contrast between the corona and a sky which is by no means dark, it must necessarily fail, as can readily be proved by attempting to photograph light, fleecy clouds near the sun (when the latter is temporarily covered by a cloud) in a daylight sky. Even with quite short exposures, the slight contrasts are lost, and longer exposures give a uniform background. As an example, I may refer to experiments by Mr. BURNHAM (with a camera $a = \frac{3}{4}$ inch, $f = 9$, stop $= \frac{f}{32}$, plate Seed 26) on photographing fleecy clouds near the totally obscured sun (which was about twenty-five degrees above the western horizon). He took four plates with times of one-fourth, one-eighth, one-sixteenth and one-thirty-second of a second. The plates were from the same box, and were developed together. There is very great improvement in the faint contrasts of cloud and fog as the time becomes shorter and shorter, and there is no doubt that a time of one-sixty-fourth second or less would have given even better results.*

The visual contrast between a faint nebula and a very dark sky may be the same as the contrast between a fairly bright corona and a fairly bright sky, and yet the two objects must be photographed according to different methods. The dark sky has little or no effect on the plate, and therefore the greater the light-ratio of the camera and the longer the exposure, the more of the nebula is shown. On the other hand, the sky at a total eclipse is actinically fairly bright (about one-tenth as bright as the polar rays in January, 1889), and if the camera has a great light-ratio and the exposure is prolonged be-

* These plates are preserved at the Lick Observatory for reference.

yond a certain limit, the slight contrast between the sky and the fainter corona will inevitably be lost.*

The problem of photographing the outer corona is the same as that of photographing light clouds near the sun, or a star in the daytime; and it appears that the failure of the mirrors of the British expeditions to show more extension than the cameras could have been predicted, even for the shorter exposures, and still more for the longer ones."

THE ASTRONOMICAL SOCIETY OF CAMDEN, NEW JERSEY.

BY A. B. DEPUY, SECRETARY.

NOTE.—A letter from Mr. DEPUY, Secretary of the Camden Astronomical Society (and also a member of the Astronomical Society of the Pacific), has lately been received, which gives an account of the organization and work of the former body. Mr. DEPUY has consented to allow extracts from his letter to be printed here, as follows:

"In the fall of 1888, I was persuaded to purchase an old reflector. After setting it up in my back-yard, I invited some of my friends to call and examine it. Among them were Mr. E. E. READ Jr., our President, and Mr. CHARLES BOWDEN. Mr. READ was the possessor of a three-inch glass of French make, considered very fine, and Mr. BOWDEN of a four-inch, by FITZ. After seeing through my "cannon," as they were pleased to call it, Mr. READ became dissatisfied with his smaller glass, and determined to purchase a large one. It was subsequently proposed that we should form ourselves into a society,

* M. A. de la BAUME PLUVINEL photographed the eclipse of December from a point near Cayenne, with five cameras of different light-ratios mounted on the same stand. He says of his results (*Comptes-Rendus*, 1890, February): "Une première comparaison des cinq épreuves montre que les objectifs les plus lumineux n'ont pas donnés des images plus complètes que les objectifs les moins lumineux. L'emploi d'instruments trop puissants n'est pas même à recommander, car l'image qu'ils donnent du ciel peut être assez intense pour se confondre avec l'image des régions peu lumineuses de la couronne."

An excellent illustration of the two methods referred to may be had by employing the same camera, *first*, to photograph the earth-light on the Moon in the dark evening sky, and, *second*, to photograph the Moon itself in broad daylight. In the first case the sky has little actinic effect and the exposure may be made, consequently, quite long—several minutes, for example. (See a note on this subject by Mr. BARNARD in the present number of the *Publications*.) In the second instance the quickest exposures will alone give good results. As an example, I may quote negatives made with the great telescope $\left(a/f = \frac{1}{17.5}\right)$ on April 23, 1890, with the Moon nearly on the meridian, about 4 P. M. An exposure of one-tenth second on Seed 26 plates gave a good contrast between the limb of the moon and the sky; other negatives taken April 26th, at 2 P.M., with the aperture contracted to fifteen inches $\left(a/f = \frac{1}{28}\right)$ and exposure of one tenth of a second on similar plates, are far more satisfactory, as the details on the moon's surface begin to show.